

PATENT ABSTRACTS OF JAPAN

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(54) SEPARATOR FOR SEALED LEAD-ACID BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To further thin a profile and to efficiently apply to a flat plate electrode as well by enhancing density in a sealed lead-acid battery having enhanced strength against electrical short-circuiting between positive and negative electrode plates of a battery by mixing mainly a fine glass fiber with an inorganic powder and natural pulp.

SOLUTION: This separator is constructed of mainly a fine glass fiber and includes an inorganic powder and natural pulp beaten and decomposed. The content of the inorganic powder is 5-30 wt.%, the content of the natural pulp is 3-20 wt.% and the density is 0.165 g/cm³ or more. The fine glass fiber is an acid resistant glass fiber having an average diameter of 1 μm or under.

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CLAIMS

[Claim(s)]

[Claim 1] The separator for sealed lead acid batteries characterized by for the content of this natural pulp being [for the content of these inorganic fine particles] 3 - 20 % of the weight at 5 - 30 % of the weight, and consistencies being three or more 0.165 g/cm in the separator for sealed lead acid batteries containing the natural pulp which was constituted as a subject and carried out beating of the detailed glass fiber to inorganic fine particles.

[Claim 2] The separator for sealed lead acid batteries characterized by this detailed glass fiber being an acid-proof glass fiber of 1 micrometer or less of diameters of average fiber in claim 1.

[Claim 3] The separator for sealed lead acid batteries characterized by these inorganic fine particles being the silica powder more than specific-surface-area of 100m²/g in claim 1 or 2.

[Claim 4] The separator for sealed lead acid batteries with which this natural pulp is characterized by carrying out beating to 250 or less mL of Canadian freshness in claim 1 thru/or any 1 term of 3.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the separator for sealed lead acid batteries, and relates to the separator for sealed lead acid batteries which raised the resistance over the electric short circuit between the positive-electrode plate of a cell, and a negative-electrode plate especially by making a detailed glass fiber into a subject and mixing inorganic fine particles and natural pulp.

[0002]

[Description of the Prior Art] As a gestalt of the separator for sealed lead acid batteries, the sheet-like separator which mainly consists of glass fibers is common. However, with the conventional separator, the phenomenon of a positive-electrode plate and a negative-electrode plate short-circuiting electrically, consequently the charge and discharge of a battery becoming impossible with the crystal growth of the metal lead in the interior of the separator at the time of penetration by local pressure of a projection of a plate, or plasmotomy or charge etc., was seen. Since the conventional separator has the comparatively low mechanical strength, penetration, it being easy to carry out plasmotomy, and a consistency are comparatively low at the projection of an electrode, and since the aperture is comparatively large, it is because growth of the metal lead from a plate also tends to occur as for this, and if the thickness of a separator becomes thin, since a mechanical strength will fall upwards more and the distance between a positive electrode and a negative electrode will become short, such a phenomenon will become much more remarkable.

[0003] It is thought that the crystal growth of metal lead can improve among the causes of this electric short circuit by carrying out densification of the separator, decreasing an opening, and checking the crystal growth within a separator. As a means for that, it is possible to hold inorganic fine particles, such as a silica, for example between glass fibers. However, if inorganic fine particles are mixed, when a tangle of glass fibers decreases because the amount of part glass fibers becomes less, consequently a mechanical strength falls remarkably, the electric short circuit resulting from pressure of a projection of an electrode will become easy to occur.

[0004] On the other hand, penetration of a separator and plasmotomy improve by raising the mechanical strength of a separator. As a means for that, the approach of mixing a synthetic fiber is well-known (for example, JP,54-22531,A, JP,56-99968,A, JP,58-663,B). However, the separator which, as for the synthetic fiber, mixed the synthetic fiber since the hydrophilic property was low compared with a glass fiber has the fault that the absorbency of sulfuric-acid liquid and solution retention are inferior.

[0005] Moreover, a mechanical strength can be raised, without the approach of mixing a beating cellulose being also well-known (JP,64-52375,A), and spoiling absorbency and solution retention in this case. However, it cannot be only come out of the consistency change by mixing of a beating cellulose, and, for a certain reason, it cannot suppress the short circuit by the crystal growth of metal lead.

[0006]

[Problem(s) to be Solved by the Invention] This invention is the separator for sealed lead acid batteries which raised the resistance over the electric short circuit between the positive-electrode plate of a cell, and a negative-electrode plate by solving the above-mentioned conventional trouble, making a detailed glass fiber into a subject, and mixing inorganic fine particles and natural pulp. The purpose is offering the separator for sealed lead acid batteries whose application made much more thinning possible and was enabled effective also in a plate electrode by raising a consistency.

[0007]

[Means for Solving the Problem] In the separator for sealed lead acid batteries containing the natural pulp which was constituted as a subject and carried out beating of the detailed glass fiber to inorganic fine particles, the content of these inorganic fine particles is 5 - 30 % of the weight, the content of this natural pulp is 3 - 20 % of the weight, and the

separator for sealed lead acid batteries of this invention is characterized by consistencies being three or more 0.165 g/cm.

[0008] In many cases, the electric short circuit between the positive electrodes and negative electrodes in a sealed lead acid battery occurs according to the following two causes.

[0009] [1] Mechanical short circuit : when projections (the irregularity of a grid, granular lump of an active material, etc.) are in a plate, the local pressure force and shearing force arise. As compared with this force, if the reinforcement of a separator is weak, penetration or plasmotomy occurs, and a projection will contact the plate of another side and will result in a short circuit.

[2] Electrochemical short circuit : if the sulfate ion in the discharge last stage and the electrolytic solution is consumed and the electrolytic solution becomes close to pure water, the solubility of lead ion will become large and a part of lead sulfate generated to the positive electrode and the negative electrode will dissolve. If it charges next, the lead ion in the electrolytic solution is returned with a negative electrode, and metal lead deposits. This crystal grows the inside of a separator, reaches the plate of another side, and results in a short circuit.

[0010] The short circuit by the cause of the above [2] is suppressed by making the path of the micropore of a separator small and carrying out densification by mixing inorganic fine particles, such as a silica, with the separator for sealed lead acid batteries of this invention. Furthermore, by mixing the natural pulp which carried out beating, the tensile strength and penetration-proof reinforcement of a separator are raised, and the short circuit by the cause of the above [1] is suppressed. Both, since these inorganic powder and natural pulp are the high ingredients of a hydrophilic property, they do not spoil the cell engine performance of a separator.

[0011] in this invention, it is based on two causes in this way -- simplistic -- since the separator which receives and has sufficient resistance can be milled at one process, it can manufacture by low cost.

[0012] And since the separator of this invention is comparatively high-density, thinning is possible for it, and an electrode spacing can apply it effective also in 0.3-0.7mm and a narrow plate electrode.

[0013] In this invention, as a detailed glass fiber, the acid-proof glass fiber of 1 micrometer or less of diameters of average fiber is desirable, and the silica powder more than specific-surface-area of 100m²/g is suitable as inorganic fine particles. As natural pulp, that by which beating was carried out to 250 or less mL of Canadian freshness is desirable.

[0014]

[Embodiment of the Invention] The gestalt of the operation of this invention to the following is explained to a detail.

[0015] The separator for sealed lead acid batteries of this invention makes a detailed glass fiber a subject, and a consistency is a three or more 0.165 g/cm thing including 5 - 30% of the weight of inorganic fine particles, and 3 - 20% of the weight of the natural pulp which carried out beating.

[0016] In this invention, as a detailed glass fiber, the acid-proof glass fiber of 1 micrometer or less of diameters of average fiber and alkali glass fiber with especially good acid resistance are desirable, and, as for the content of this detailed glass fiber, it is desirable that it is 50 - 92 % of the weight. If the diameter of average fiber of a detailed glass fiber exceeds 1 micrometer, liquid holding power, paper-milling nature, etc. will fall. Moreover, if less than 50 % of the weight of liquid holding power is [the content] insufficient and it exceeds 92 % of the weight, the content of inorganic fine particles and natural pulp will decrease relatively, and sufficient short circuit-proof nature will not be obtained.

[0017] When less than 5 % of the weight of the content of inorganic fine particles is not enough as the short circuit prevention effectiveness and it exceeds 30 % of the weight, the rate of a detailed glass fiber or natural pulp decreases relatively, and a mechanical strength is inferior. Therefore, the content of inorganic fine particles is made into 5 - 30 % of the weight.

[0018] As these inorganic fine particles, although a silica, a titanium dioxide, diatomaceous earth, etc. can be used, it is desirable to use the silica powder more than specific-surface-area of 100m²/g by the high hydrophilic property from the point which is low cost. If it is the silica powder more than specific-surface-area of 100m²/g, there is much pore on the interior of a particle and the front face of a particle, and it is excellent in the solution retention improvement effectiveness of the electrolytic solution.

[0019] The content of the natural pulp which carried out beating cannot compensate enough the fall on the strength by inorganic powder mixing with less than 3 % of the weight, but the effectiveness over a short circuit is low. However, if this content exceeds 20 % of the weight, a separator will become hard too much and adhesion with a plate will fall. Therefore, the content of natural pulp is made into 3 - 20 % of the weight.

[0020] It is desirable to use what carried out beating of the pulp of a needle-leaf tree system with the beater etc. as this natural pulp. That is, needle-leaf tree system pulp can acquire the extremely excellent reinforcement effectiveness from fiber length being long and being homogeneous. When extent of the beating is expressed with Canadian freshness

(Canada standard freshness), it is desirable that 250 or less mLs are especially 150 or less mLs by 0.3-% of the weight concentration (in addition, the freshness of the natural pulp which has not carried out beating is 600 or more mLs.). If it is the natural pulp by which beating was carried out to such freshness, it has one several times the very big pore volume [usual specific surface area and pore volume] of pulp, and excels in reactivity, a hydrophilic property, water retention, etc., and acid resistance is also high, since it has the reinforcement effectiveness which was moreover excellent, the reinforcement and the degree of hardness of a separator can be remarkably increased by little addition, and solution retention and absorbency will not be spoiled.

[0021] In this invention, this natural pulp may substitute a fibrillation cellulose for that part. A fibrillation cellulose makes natural pulp detailed even to microfibril, and is effective in improvement in a mechanical strength. However, when blending a fibrillation cellulose, it is made for the loadings of the sum total with the natural pulp which made that content 5 or less % of the weight, and carried out beating to the fibrillation cellulose to become 20 or less % of the weight, since a separator will become hard too much and adhesion with a plate will fall, if the content of this fibrillation cellulose exceeds 5 % of the weight.

[0022] The separator for sealed lead acid batteries of this invention can manufacture the above-mentioned component by following a conventional method, and mixing and milling paper preferably, or more [0.165g //cm] 3 consistency, so that it may become three or more 0.165 - 0.250 g/cm.

[0023] In this invention, the opening of a separator increases that the consistencies of a separator are less than three 0.165 g/cm, and when it considers as the separator for plate electrodes with thin thickness, sufficient short circuit-proof nature cannot be obtained. If a consistency becomes higher than 0.250 g/cm³, since solution retention etc. will fall, the consistency of a separator is preferably made into 0.165 - 0.250 g/cm³.

[0024] In this invention, even if it is the comparatively thin separator which it says is 0.4-0.8mm (thickness by the measuring method in the below-mentioned example) in thickness by considering as such a separator with a comparatively high consistency, sufficient short circuit prevention effectiveness can be acquired.

[0025] Such a separator for sealed lead acid batteries of this invention is very useful as a separator for plate electrodes.

[0026] [Example] Although an example and the example of a comparison are given to below and this invention is more concretely explained to it, this invention is not limited to the following examples, unless the summary is exceeded. In addition, the ingredient used in the following examples and examples of a comparison is as follows.

[0027]

[Material of construction]

Glass fiber : 0.8 micrometers [of average fiber ****] alkali glass fiber Silica powder : Silica powder of specific-surface-area of about 200m²/g Natural pulp which carried out beating: Needle-leaf tree system pulp Canadian freshness abbreviation 150mL What carried out beating Thermoplastic organic fiber : It is about 5m in 20 micrometers of average fiber ****, and fiber length. Polyester fiber The separator for batteries was manufactured by the ingredient combination shown in one to examples 1 and 2 and example of comparison 4 table 1, and measurement results, such as many of the properties, were shown in Table 1. In addition, each measuring method etc. is as follows.

[0028] ** Thickness (mm) and a consistency (g/cm³)

It asked for thickness T (SBA4501) which measured the sample in the condition of having pressed by the pressure of 0.2 kgf/cm² in the thickness direction, and the consistency was computed by $W/(TxS)$ from the mass W measured with this thickness T and an electronic balance, and the area S of a sample.

** Tensile strength (gf/10mm²)

It is based on SBA4501.

** Measure the maximum load at the time of forcing perpendicularly the needle which has a spherical tip at the rate of 120 mm/min to the fixed sample, and penetrating by 1mm of penetration sizes on the strength. Since this measured value was influenced by the form letter rack with a minute needle tip, relative evaluation was made on the result of the example 1 of a comparison as 100 in the ratio with the measured value in a standard sample (thing of the example 1 of a comparison).

[0029] ** Absorbency (mm/min)

A sample is made perpendicular, the lower part is immersed in the dilute sulfuric acid of specific gravity 1.30, and it asks by measuring the liquid level which goes up in 1 minute from the time of immersion.

[0030] ** Between the monotonous lead electrode plates (an electrode area of about 7mm²) of two electrochemical short circuit duration, it arranges on both sides of a separator with a thickness of 0.5mm, and is immersed into the saturated solution of a lead sulfate. Furthermore, where the pressure force of 0.3 kgf/m² is applied, regularity electrical-potential-difference 10V are impressed to this. If the metal lead which grew from the negative electrode reaches a

positive electrode, since inter-electrode resistance will decrease rapidly, this time amount is measured and it is the thickness of a separator, and it is ****. This measured value made relative evaluation on the result of the example 1 of a comparison as 100 in the ratio with the measured value in a standard sample (thing of the example 1 of a comparison).

[0031] Penetration reinforcement is the index of a mechanical short circuit among the above-mentioned characterization, and a mechanical short circuit cannot occur easily, so that penetration reinforcement is high.

Moreover, electrochemical short circuit duration is excellent in the short circuit prevention effectiveness, so that it is long.

[0032]

[Table 1]

		実施例		比較例			
		1	2	1	2	3	4
配合 (重量%)	ガラス繊維	80	75	100	80	75	90
	シリカ粉末	10	20			20	
	叩解パルプ	10	5				10
	熱可塑性有機繊維				20	5	
特性等	厚さ (mm)	0.5	0.5	0.5	0.5	0.5	0.5
	密度 (g/cm ³)	0.18	0.20	0.14	0.15	0.20	0.15
	引張強度 (gf/10mm ²)	480	360	440	660	300	720
	貫通強度 ※	190	120	100	270	70	200
	吸液性 (mm/min)	50	50	50	40	45	50
	電気化学的短絡時間 ※	4500	6000	100	250	1600	300

※ : 比較例1の結果を100とする相対値。

[0033] The following thing is clearer than Table 1.

[0034] That is, in the example 1 of a comparison of only a glass fiber, penetration reinforcement is low and its short circuit duration is also short. In the example 2 of a comparison of only a glass fiber and organic fiber, although penetration reinforcement is high, short circuit duration is comparatively short, and absorbency is also inferior in it. In the example 3 of a comparison which blended organic fiber with a glass fiber and silica powder, although short circuit duration is long, penetration reinforcement is very low. In the example 4 of a comparison of only a glass fiber and beating pulp, penetration reinforcement is high, and although absorbency is also good, short circuit duration is comparatively short.

[0035] on the other hand, in the examples 1 and 2 which blended a glass fiber, silica powder, and beating pulp at a predetermined rate, without spoiling absorbency, high penetration reinforcement and long short circuit duration are filled to coincidence, and it is based on the two above-mentioned causes -- simplistic -- it receives and is very effective.

[0036]

[Effect of the Invention] According to the separator for sealed lead acid batteries of this invention, the following effectiveness is done so, the electric short circuit of the positive-electrode plate of a sealed lead acid battery and a negative-electrode plate cannot occur easily, it excels also in separator properties, such as absorbent ability, upwards, and the cheap separator for sealed lead acid batteries is offered as explained in full detail above. Especially the separator for sealed lead acid batteries of this invention is very effective in the thinning as a separator for high property plate electrode plates.

[0037] (1) Inorganic powder is held between the glass fibers of a separator, and it is high-density. The inorganic powder in the pore of a separator serves to bar the crystal growth of metal lead. Moreover, the microfilament of the natural pulp which carried out beating also carries out the same work. For this reason, the electric short circuit by the crystal growth of metal lead cannot occur easily.

(2) The natural pulp which carried out beating raises the mechanical strength, especially penetration reinforcement of a

separator. For this reason, penetration by the local pressure force in the projection of an electrode plate and plasmotomy cannot occur easily.

(3) Since it consists of only high ingredients of a hydrophilic property, a hydrophilic property and solution retention are high and the cell engine performance is good.

(4) It can manufacture easily at single mixing and a paper-milling process, and is low cost.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the separator for sealed lead acid batteries, and relates to the separator for sealed lead acid batteries which raised the resistance over the electric short circuit between the positive-electrode plate of a cell, and a negative-electrode plate especially by making a detailed glass fiber into a subject and mixing inorganic fine particles and natural pulp.

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PRIOR ART

[Description of the Prior Art] As a gestalt of the separator for sealed lead acid batteries, the sheet-like separator which mainly consists of glass fibers is common. However, with the conventional separator, the phenomenon of a positive-electrode plate and a negative-electrode plate short-circuiting electrically, consequently the charge and discharge of a battery becoming impossible with the crystal growth of the metal lead in the interior of the separator at the time of penetration by local pressure of a projection of a plate, or plasmotomy or charge etc., was seen. Since the conventional separator has the comparatively low mechanical strength, penetration, it being easy to carry out plasmotomy, and a consistency are comparatively low at the projection of an electrode, and since the aperture is comparatively large, it is because growth of the metal lead from a plate also tends to occur as for this, and if the thickness of a separator becomes thin, since a mechanical strength will fall upwards more and the distance between a positive electrode and a negative electrode will become short, such a phenomenon will become much more remarkable.

[0003] It is thought that the crystal growth of metal lead can improve among the causes of this electric short circuit by carrying out densification of the separator, decreasing an opening, and checking the crystal growth within a separator. As a means for that, it is possible to hold inorganic fine particles, such as a silica, for example between glass fibers. However, if inorganic fine particles are mixed, when a tangle of glass fibers decreases because the amount of part glass fibers becomes less, consequently a mechanical strength falls remarkably, the electric short circuit resulting from pressure of a projection of an electrode will become easy to occur.

[0004] On the other hand, penetration of a separator and plasmotomy improve by raising the mechanical strength of a separator. As a means for that, the approach of mixing a synthetic fiber is well-known (for example, JP,54-22531,A, JP,56-99968,A, JP,58-663,B). However, the separator which, as for the synthetic fiber, mixed the synthetic fiber since the hydrophilic property was low compared with a glass fiber has the fault that the absorbency of sulfuric-acid liquid and solution retention are inferior.

[0005] Moreover, a mechanical strength can be raised, without the approach of mixing a beating cellulose being also well-known (JP,64-52375,A), and spoiling absorbency and solution retention in this case. However, it cannot be only come out of the consistency change by mixing of a beating cellulose, and, for a certain reason, it cannot suppress the short circuit by the crystal growth of metal lead.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to the separator for sealed lead acid batteries of this invention, the following effectiveness is done so, the electric short circuit of the positive-electrode plate of a sealed lead acid battery and a negative-electrode plate cannot occur easily, it excels also in separator properties, such as absorbent ability, upwards, and the cheap separator for sealed lead acid batteries is offered as explained in full detail above. Especially the separator for sealed lead acid batteries of this invention is very effective in the thinning as a separator for high property plate electrode plates.

[0037] (1) Inorganic powder is held between the glass fibers of a separator, and it is high-density. The inorganic powder in the pore of a separator serves to bar the crystal growth of metal lead. Moreover, the microfilament of the natural pulp which carried out beating also carries out the same work. For this reason, the electric short circuit by the crystal growth of metal lead cannot occur easily.

(2) The natural pulp which carried out beating raises the mechanical strength, especially penetration reinforcement of a separator. For this reason, penetration by the local pressure force in the projection of an electrode plate and plasmotomy cannot occur easily.

(3) Since it consists of only high ingredients of a hydrophilic property, a hydrophilic property and solution retention are high and the cell engine performance is good.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] This invention is the separator for sealed lead acid batteries which raised the resistance over the electric short circuit between the positive-electrode plate of a cell, and a negative-electrode plate by solving the above-mentioned conventional trouble, making a detailed glass fiber into a subject, and mixing inorganic fine particles and natural pulp. The purpose is offering the separator for sealed lead acid batteries whose application made much more thinning possible and was enabled effective also in a plate electrode by raising a consistency.

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MEANS

[Means for Solving the Problem] In the separator for sealed lead acid batteries containing the natural pulp which was constituted as a subject and carried out beating of the detailed glass fiber to inorganic fine particles, the content of these inorganic fine particles is 5 - 30 % of the weight, the content of this natural pulp is 3 - 20 % of the weight, and the separator for sealed lead acid batteries of this invention is characterized by consistencies being three or more 0.165 g/cm.

[0008] In many cases, the electric short circuit between the positive electrodes and negative electrodes in a sealed lead acid battery occurs according to the following two causes.

[0009] [1] Mechanical short circuit : when projections (the irregularity of a grid, granular lump of an active material, etc.) are in a plate, the local pressure force and shearing force arise. As compared with this force, if the reinforcement of a separator is weak, penetration or plasmotomy occurs, and a projection will contact the plate of another side and will result in a short circuit.

[2] Electrochemical short circuit : if the sulfate ion in the discharge last stage and the electrolytic solution is consumed and the electrolytic solution becomes close to pure water, the solubility of lead ion will become large and a part of lead sulfate generated to the positive electrode and the negative electrode will dissolve. If it charges next, the lead ion in the electrolytic solution is returned with a negative electrode, and metal lead deposits. This crystal grows the inside of a separator, reaches the plate of another side, and results in a short circuit.

[0010] The short circuit by the cause of the above [2] is suppressed by making the path of the micropore of a separator small and carrying out densification by mixing inorganic fine particles, such as a silica, with the separator for sealed lead acid batteries of this invention. Furthermore, by mixing the natural pulp which carried out beating, the tensile strength and penetration-proof reinforcement of a separator are raised, and the short circuit by the cause of the above [1] is suppressed. Both, since these inorganic powder and natural pulp are the high ingredients of a hydrophilic property, they do not spoil the cell engine performance of a separator.

[0011] in this invention, it is based on two causes in this way -- simplistic -- since the separator which receives and has sufficient resistance can be milled at one process, it can manufacture by low cost.

[0012] And since the separator of this invention is comparatively high-density, thinning is possible for it, and an electrode spacing can apply it effective also in 0.3-0.7mm and a narrow plate electrode.

[0013] In this invention, as a detailed glass fiber, the acid-proof glass fiber of 1 micrometer or less of diameters of average fiber is desirable, and the silica powder more than specific-surface-area of 100m²/g is suitable as inorganic fine particles. As natural pulp, that by which beating was carried out to 250 or less mL of Canadian freshness is desirable.

[0014]

[Embodiment of the Invention] The gestalt of the operation of this invention to the following is explained to a detail.

[0015] The separator for sealed lead acid batteries of this invention makes a detailed glass fiber a subject, and a consistency is a three or more 0.165 g/cm thing including 5 - 30% of the weight of inorganic fine particles, and 3 - 20% of the weight of the natural pulp which carried out beating.

[0016] In this invention, as a detailed glass fiber, the acid-proof glass fiber of 1 micrometer or less of diameters of average fiber and alkali glass fiber with especially good acid resistance are desirable, and, as for the content of this detailed glass fiber, it is desirable that it is 50 - 92 % of the weight. If the diameter of average fiber of a detailed glass fiber exceeds 1 micrometer, liquid holding power, paper-milling nature, etc. will fall. Moreover, if less than 50 % of the weight of liquid holding power is [the content] insufficient and it exceeds 92 % of the weight, the content of inorganic fine particles and natural pulp will decrease relatively, and sufficient short circuit-proof nature will not be obtained.

[0017] When less than 5 % of the weight of the content of inorganic fine particles is not enough as the short circuit

prevention effectiveness and it exceeds 30 % of the weight, the rate of a detailed glass fiber or natural pulp decreases relatively, and a mechanical strength is inferior. Therefore, the content of inorganic fine particles is made into 5 - 30 % of the weight.

[0018] As these inorganic fine particles, although a silica, a titanium dioxide, diatomaceous earth, etc. can be used, it is desirable to use the silica powder more than specific-surface-area of 100m²/g by the high hydrophilic property from the point which is low cost. If it is the silica powder more than specific-surface-area of 100m²/g, there is much pore on the interior of a particle and the front face of a particle, and it is excellent in the solution retention improvement effectiveness of the electrolytic solution.

[0019] The content of the natural pulp which carried out beating cannot compensate enough the fall on the strength by inorganic powder mixing with less than 3 % of the weight, but the effectiveness over a short circuit is low. However, if this content exceeds 20 % of the weight, a separator will become hard too much and adhesion with a plate will fall. Therefore, the content of natural pulp is made into 3 - 20 % of the weight.

[0020] It is desirable to use what carried out beating of the pulp of a needle-leaf tree system with the beater etc. as this natural pulp. That is, needle-leaf tree system pulp can acquire the extremely excellent reinforcement effectiveness from fiber length being long and being homogeneous. When extent of the beating is expressed with Canadian freshness (Canada standard freshness), it is desirable that 250 or less mLs are especially 150 or less mLs by 0.3-% of the weight concentration (in addition, the freshness of the natural pulp which has not carried out beating is 600 or more mLs.). If it is the natural pulp by which beating was carried out to such freshness, it has one several times the very big pore volume [usual specific surface area and pore volume] of pulp, and excels in reactivity, a hydrophilic property, water retention, etc., and acid resistance is also high, since it has the reinforcement effectiveness which was moreover excellent, the reinforcement and the degree of hardness of a separator can be remarkably increased by little addition, and solution retention and absorbency will not be spoiled.

[0021] In this invention, this natural pulp may substitute a fibrillation cellulose for that part. A fibrillation cellulose makes natural pulp detailed even to microfibril, and is effective in improvement in a mechanical strength. However, when blending a fibrillation cellulose, it is made for the loadings of the sum total with the natural pulp which made that content 5 or less % of the weight, and carried out beating to the fibrillation cellulose to become 20 or less % of the weight, since a separator will become hard too much and adhesion with a plate will fall, if the content of this fibrillation cellulose exceeds 5 % of the weight.

[0022] The separator for sealed lead acid batteries of this invention can manufacture the above-mentioned component by following a conventional method, and mixing and milling paper preferably, or more [0.165g //cm] 3 consistency, so that it may become three or more 0.165 - 0.250 g/cm.

[0023] In this invention, the opening of a separator increases that the consistencies of a separator are less than three 0.165 g/cm, and when it considers as the separator for plate electrodes with thin thickness, sufficient short circuit-proof nature cannot be obtained. If a consistency becomes higher than 0.250 g/cm³, since solution retention etc. will fall, the consistency of a separator is preferably made into 0.165 - 0.250 g/cm³.

[0024] In this invention, even if it is the comparatively thin separator which it says is 0.4-0.8mm (thickness by the measuring method in the below-mentioned example) in thickness by considering as such a separator with a comparatively high consistency, sufficient short circuit prevention effectiveness can be acquired.

[0025] Such a separator for sealed lead acid batteries of this invention is very useful as a separator for plate electrodes.

[Translation done.]

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

EXAMPLE

[Example] Although an example and the example of a comparison are given to below and this invention is more concretely explained to it, this invention is not limited to the following examples, unless the summary is exceeded. In addition, the ingredient used in the following examples and examples of a comparison is as follows.

[0027]

[Material of construction]

Glass fiber : 0.8 micrometers [of average fiber ****] alkali glass fiber Silica powder : Silica powder of specific-surface-area of about 200m²/g Natural pulp which carried out beating: Needle-leaf tree system pulp Canadian freshness abbreviation 150mL What carried out beating Thermoplastic organic fiber : It is about 5m in 20 micrometers of average fiber ****, and fiber length. Polyester fiber The separator for batteries was manufactured by the ingredient combination shown in one to examples 1 and 2 and example of comparison 4 table 1, and measurement results, such as many of the properties, were shown in Table 1. In addition, each measuring method etc. is as follows.

[0028] ** Thickness (mm) and a consistency (g/cm³)

It asked for thickness T (SBA4501) which measured the sample in the condition of having pressed by the pressure of 0.2 kgf/cm² in the thickness direction, and the consistency was computed by $W/(TxS)$ from the mass W measured with this thickness T and an electronic balance, and the area S of a sample.

** Tensile strength (gf/10mm²)

It is based on SBA4501.

** Measure the maximum load at the time of forcing perpendicularly the needle which has a spherical tip at the rate of 120 mm/min to the fixed sample, and penetrating by 1mm of penetration sizes on the strength. Since this measured value was influenced by the form letter rack with a minute needle tip, relative evaluation was made on the result of the example 1 of a comparison as 100 in the ratio with the measured value in a standard sample (thing of the example 1 of a comparison).

[0029] ** Absorbency (mm/min)

A sample is made perpendicular, the lower part is immersed in the dilute sulfuric acid of specific gravity 1.30, and it asks by measuring the liquid level which goes up in 1 minute from the time of immersion.

[0030] ** Between the monotonous lead electrode plates (an electrode area of about 7mm²) of two electrochemical short circuit duration, it arranges on both sides of a separator with a thickness of 0.5mm, and is immersed into the saturated solution of a lead sulfate. Furthermore, where the pressure force of 0.3 kgf/m² is applied, regularity electrical-potential-difference 10V are impressed to this. If the metal lead which grew from the negative electrode reaches a positive electrode, since inter-electrode resistance will decrease rapidly, this time amount is measured and it is the thickness of a separator, and it is ****. This measured value made relative evaluation on the result of the example 1 of a comparison as 100 in the ratio with the measured value in a standard sample (thing of the example 1 of a comparison).

[0031] Penetration reinforcement is the index of a mechanical short circuit among the above-mentioned characterization, and a mechanical short circuit cannot occur easily, so that penetration reinforcement is high. Moreover, electrochemical short circuit duration is excellent in the short circuit prevention effectiveness, so that it is long.

[0032]

[Table 1]

		実施例		比較例			
		1	2	1	2	3	4
配合 (重量%)	ガラス繊維	80	75	100	80	75	90
	シリカ粉末	10	20			20	
	叩解パルプ	10	5				10
	熱可塑性 有機繊維				20	5	
特性等	厚さ (mm)	0.5	0.5	0.5	0.5	0.5	0.5
	密度 (g/cm ³)	0.18	0.20	0.14	0.15	0.20	0.15
	引張強度 (gf/10mm ²)	480	360	440	660	300	720
	貫通強度 ※	190	120	100	270	70	200
	吸液性 (mm/min)	50	50	50	40	45	50
	電気化学的 短絡時間 ※	4500	6000	100	250	1600	300

※ : 比較例1の結果を100とする相対値。

[0033] The following thing is clearer than Table 1.

[0034] That is, in the example 1 of a comparison of only a glass fiber, penetration reinforcement is low and its short circuit duration is also short. In the example 2 of a comparison of only a glass fiber and organic fiber, although penetration reinforcement is high, short circuit duration is comparatively short, and absorbency is also inferior in it. In the example 3 of a comparison which blended organic fiber with a glass fiber and silica powder, although short circuit duration is long, penetration reinforcement is very low. In the example 4 of a comparison of only a glass fiber and beating pulp, penetration reinforcement is high, and although absorbency is also good, short circuit duration is comparatively short.

[0035] on the other hand, in the examples 1 and 2 which blended a glass fiber, silica powder, and beating pulp at a predetermined rate, without spoiling absorbency, high penetration reinforcement and long short circuit duration are filled to coincidence, and it is based on the two above-mentioned causes -- simplistic -- it receives and is very effective.

[Translation done.]